# XVIII. *A Letter from* Thomas Ronayne, *Eſq*; *to* Benjamin Franklin, *LL. D. F. R. S. incloſing an Account of ſome Obſervations on Atmoſpherical Electricity; in regard of Fogs, Miſts, &c. with ſome Remarks; communicated by Mr.* William Henley.

S I R,

Read April 30, 1772.

IN conformity to the deſire of ſome friends, I have drawn up the following obſervations on atmoſpherical electricity, which I beg leave to lay before you; and ſhall think the trouble I have had, in proſecuting the neceſſary experiments, ſufficiently compenſated, if it ſhall appear to you that they contain any thing new or curious; in which caſe, you are at liberty to diſpoſe of them in whatever manner you ſhall think proper.

I am, S I R,

With very reſpectful conſideration,

Your moſt obedient ſervant,

Cecil-Street,
Feb. 15, 1772.

Tho$^s$ Ronayne.

* SOME years ago I diſcovered, by Mr. Canton's electrometer, deſcribed in the Philoſ. Tranſactions, Vol. XLVIII. p. 783. that the air of Ireland is, during the winter ſeaſon, in almoſt a conſtant ſtate of poſitive electricity; which, however, is ſo weak, that, in order to obſerve it ſatisfactorily, I have always found it neceſſary to have the cork-balls ſuſpended from threads of a middling fineneſs, ſix or ſeven inches in length, quite ſtreight, and to avoid, as much as poſſible, any interruption from the wind.

I have likewiſe had frequent recourſe to the following contrivance, by which I was enabled, within doors, to purſue my inquiries with greater accuracy and advantage: having procured a ſlender tapering piece of wood, about five feet long, to the ſmaller end of which an electrometer was affixed, by means of a ſmall hook; I placed it out from an open garret window, and faſtened the other end with a ſmall haſp to one of the jambs: I had alſo at hand another piece of wood, in the ends of which, a ſmall glaſs tube and a ſtick of ſealing-wax had been inſerted. Either of theſe was occaſionally excited, and applied near the cork-balls, in order to determine more preciſely the kind of electricity with which they might happen to be affected; and I was always careful in

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* I commenced my experiments on the air in the year 1761, and thoſe on the clouds in the year 1762. I continued them unremittingly, as opportunity offered, till the year 1770, when my occaſions brought me to England. I have repeated my experiments, with regard to the common air, in different places here, and find it the ſame as that in Ireland.

making my experiments on that ſide of the houſe where the wind had leaſt power.

I have found the air, in winter, at a proper diſtance from buildings, trees, maſts of ſhips, &c. very ſenſibly electrified, during a froſty or foggy ſtate of the weather; and in miſts too, but in a leſs degree: I have alſo diſcovered ſmall ſigns of it in calm and cloudy weather.

The air, in ſummer, never ſhewed any ſign of electricity, except when a fog happened in the cool of the evening, or at night; in which caſe, I always diſcovered manifeſt marks of electricity, ſenſibly weaker than thoſe obſerved in winter fogs, but preciſely of the ſame kind, that is, *poſitive*.

I have often examined the ſtate of the air, at the time of an Aurora borealis, and could not diſcover any indication of electricity, except when a fog had appeared at the ſame time; in which caſe, the electricity has been, in every reſpect, the ſame as that of a fog at any other time. Once, indeed, during an Aurora borealis on a remarkable ſerene night, I diſcovered ſome ſigns of a very weak *poſitive* electricity.

As the electricity of the air is generally *poſitive* (I never knew an exception but one, which preſented itſelf during a fog on a winter day, that proved uncommonly warm), is it not reaſonable to believe, that cold electrifies the atmoſphere *poſitively?* and, if ſo, may not one be led to imagine, that heat electrifies it *negatively?* But this I only offer as a conjecture, not being able to advance any thing deciſive on the ſubject, and knowing that one ſort of electricity may often be productive of the other, as is plain from Dr. Franklin's experiments.

If cold electrifies the air *poſitively* in this climate (which ſeems extremely probable), may it not electrify it *negatively* at and about the place of our antipodes? Does not a conſideration of the effects diſcovered in the Tourmalin favour this ſurmiſe?

The electricity of the air, in froſty, foggy or miſty weather, is not ſtrong enough to yield any ſpark, even by inſulating a ſharp pointed wire in it, which, however, attracts very light bodies at a ſmall diſtance; whilſt, on the contrary, that of the clouds generally affords conſiderably ſtrong ſparks.

When a fog becomes very thick, the cork-balls approach; but when it returns to its former ſtate, they open again at their firſt diſtance; and I have obſerved that, when it rained in foggy weather, the balls cloſed, and opened again on the fog's appearance anew, after the rain had ceaſed: there is, however, a certain degree of denſity neceſſary in a fog, in order that the balls might exert their greateſt divergency.

Moſt, if not all, fogs partake of a ſmell much like that of an excited glaſs tube, and, indeed, ſo does the common air very frequently.

As fogs ſometimes appear in a very moiſt ſtate of the air, I was for ſome time at a loſs to account on what principle they could retain their electricity; but having at length remarked, that electrified bodies, inſulated with ſealing-wax, preſerved their electricity for a time in very damp air, I concluded that moiſture is but a very ſlow conductor.

Having,

Having, on the contrary, obſerved that bodies, inſulated with dried ſilk, had loſt their electricity in a very ſhort time, I attempted to render it a non-conductor, by having varniſhed it over with oil of turpentine, balſam of ſulphur, and ſuch like, but did not ſucceed; for ſilks ſo treated ſoon became a conductor, and increaſed conſiderably in weight, if the air happened not to be very * dry; ſo much indeed, that I think ordinary ſilk, from its power of abſorbing moiſture from the air, may well ſerve as an occaſional hygrometer, either by being put into a balance, or by having an electrified body inſulated with it.

When the denſity of fogs, floating near the earth, increaſes conſiderably, the balls always approach; but when they are ſituated high in air, the reverſe generally happens. I had an opportunity of remarking a ſtruggle between breezes from the north-weſt and ſouth-eaſt at the ſame time, in which the one ſeemed ſometimes to prevail, and afterwards the other. This contention was ſucceeded by a ſmoaky hazineſs, which, like a fog, occaſioned the balls to open: as the hazineſs † thickened, they opened

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* Even glaſs attracts moiſture to its ſurface, which makes it a conductor of electricity, and, conſequently, not ſo convenient as ſealing-wax.

† An electrical body, when contracted in its dimenſion, will have its electricity increaſed, as appears by Dr. Franklin's curious experiment with the chain and ſilver can. I alſo have diſcovered, from repeated trials, that a piece of flannel, ſilk, &c. excited, and ſuddenly twiſted, not only ſtruck at a greater diſtance than before, but ſometimes emitted pencils of fire into the air. May we not hence infer why the electricity of vapour, &c. (when not in contact with the earth) increaſes by condenſation?

wider, and ſtill wider when it diſſolved into rain, but their repelling power became greateſt in proportion as the drops increaſed.

The electrometer placed out from a garret window (p. 138.), has been frequently uſeful to me, in determining the nature of an approaching cloud, whoſe electricity, although generally ſtrong, was for the moſt part uncertain, having been ſometimes *poſitive*, and at other times *negative*. But, as the wind or rain were frequent impediments to the accuracy of my experiments, the following methods of making obſervations, with ſucceſs, under ſhelter, occurred to me.

I have ſometimes ſtood, in an upper room, on a cake of wax, holding in my right hand, out at the window, a long ſlender piece of wood, round which a wire projecting a few inches had been twiſted, and in my left hand an electrometer: an aſſiſtant had excited glaſs or wax in readineſs.

At other times, I have made uſe of a tapering tube of tin, twenty feet long, ending in a point; the greateſt part of it ſtood out high in the air, and the thick end, from which an electrometer hung, was ſupported inſide the window, ſometimes with ſilk cords, and at other times with ſtrong ſticks of ſealing-wax, ſuſtained at either end by hooks of iron-wire.

By either of theſe means I have often diſcovered, that what ſeemed to me a ſingle cloud, produced, in its paſſing over, ſeveral ſucceſſive changes, from *poſitive* to *negative*, and from *negative* to *poſitive* electricity, the balls coming together each time, and remaining in contact a few ſeconds, before they repelled each other again.

The permanence of either kind of electricity in the clouds, or the length of time in which neither can be diſcovered, is uncertain; ſometimes the ſame electricity has returned, and at other times has been ſucceeded by the contrary; whilſt either generally came on, and went off gradually. But changes were often made, very ſuddenly, by a flaſh of lightning, eſpecially if the thunder-ſtorm happened to be in the zenith. A branch of it, over-head, has frequently occaſioned ſtronger electricity than I could diſcover, when the greateſt part of the ſky had been overcaſt; which, perhaps, might be accounted for, from this conſideration, that one kind of electricity acting alone, muſt exert more powerful effects than when counteracted by the other.

I once obſerved in a thunder-ſtorm, during which I ſaw no lightning, that the balls, which hung from the tin tube, repelled and attracted each other, very rapidly, for the ſpace of ten or twelve ſeconds; at the ſame time, Mr. Canton's electrometer, which I held at ſuch a diſtance from the tube, as to have its balls opened to the diſtance of an inch, continued quiet in that ſtate, and were not affected convulſively like the others. Hence I imagined, that the ſame kind of electricity went off, and came on, without being changed *in contrarium*; for when that circumſtance happened, they were very evidently affected in the ſame manner. And here I muſt obſerve, that I have found it more eaſy to diſcover the kind of electricity preſent in the tube, by approaching excited wax to the balls of an electrometer, which I held at a proper diſtance from the tube, than by applying it near the balls which hung from the tube;

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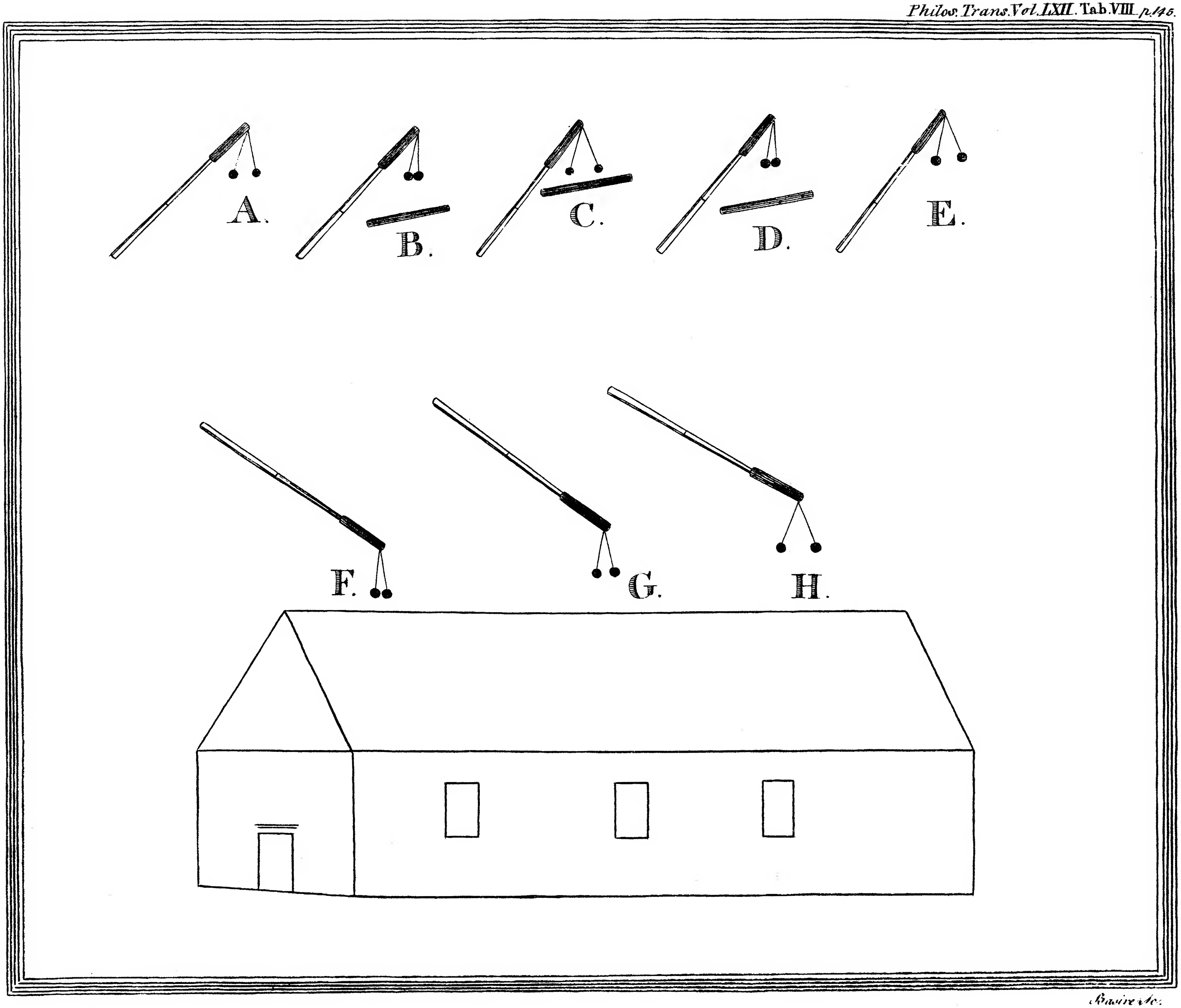
for they, in the general, diverged ſo much, that I found it very difficult to have in readineſs a ſmall tube of glaſs, or wax ſufficiently excited to affect them.

It has ſometimes happened that the balls of the tin tube, &c. perfectly at reſt, have, in conſequence of a flaſh of lightning, ſuddenly repelled each other, and immediately after cloſed. As this circumſtance has frequently happened, when the air was in a damp ſtate, I have ſometimes imagined that the equilibrium between the earth and lower clouds had been quickly reſtored, on receiving the electricity of the higher ones; and, at other times, have ſuppoſed that it might be owing to the lateral effect of the exploſion.

If two or more perſons, at a ſufficient diſtance from each other, would correſpond, by ſignals, viz. a red flag for *poſitive*, and a blue one for *negative* electricity, we ſhould probably obtain, in due time, more ſatisfactory certainty with regard to the electricity of the clouds, thunder, &c. than has hitherto been given, or is, perhaps, poſſible for any one man to acquire, without the aid of wires or chains, produced from different apparatuſſes, placed at different diſtances from each other.



*Basire sc.*

Mr. Ronayne having received the following Letter from Mr. Henly, which corroborates and confirms the obſervations mentioned in his paper, it was thought proper to print them together in this volume.

October 16, 1771, ¼ paſt 5, P. M.

I Find a fog (not very thick), ſoon after its appearance, ſtrongly electrical. The balls open ½ or ¾ inch A, [See Tab. VIII.], and cloſe at the approach of excited wax, when brought within 10 inches of them B: if the wax is brought within 3 or 4 inches, they diverge again, in conſequence thereof C: as the wax is withdrawn, they converge again, D, till it gets beyond the diſtance of its influence, when they begin to diverge again; and, as the wax is withdrawn ſtill farther, they continue to open, in conſequence of the electricity in the fog, till they reach their original diſtance from each other E. There is very little diſturbance by the wind, and the little there is, only wafts them in a ſmall degree, but they keep ſeparate. If they are held near the tiling, or brick-work, of a neighbouring houſe, they cloſe, F; but begin to diverge again, at the diſtance of 3 or 4 feet from it, G; and their divergence increaſes, as they recede from the building, till they ſeparate ½ or ¾ inch, as at firſt, H.

## MEMORANDUM.

October 3, 1771, I tried the electricity of a thick fog, and (in at leaſt twenty different trials) found the balls ſeparated from $\frac{1}{4}$ to $\frac{3}{4}$ inch diſtance. Whenever I brought them near the building, or approached them with a ſtick of excited wax, they cloſed; and opened again, on removing them.

W. Henly.